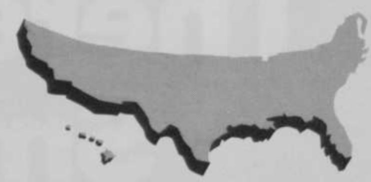
The related functions of water and turfgrasses



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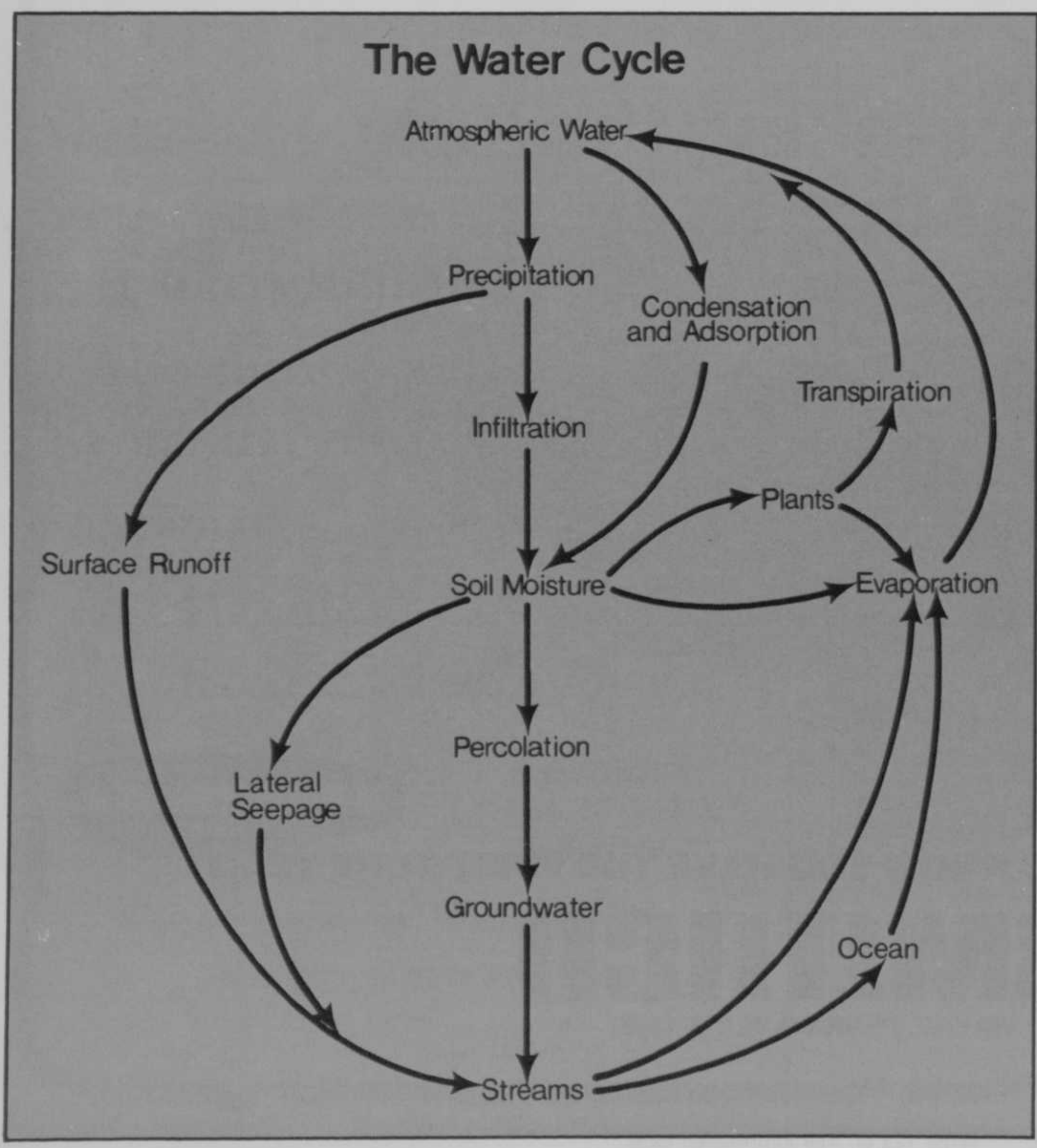
Water performs four basic functions to the grass plant: it cools, carries nutrients, provides structural support, and is essential to biochemical aspects of plant metabolism.

Most water used by grass passes from soil through the plant and into the air by evaporation from the leaves, cooling them because water vapor carries a lot of heat with it. If that heat stayed with the leaf it would reach lethal levels under full sun in summer. Under a full turf cover only a small fraction of total water applied evaporates from soil or leaf surfaces. The remainder runs off or enters the soil.

Four factors interact to determine water use by grasses. These are: 1) The microclimatic conditions under which the grass is growing; 2) The grass itself; 3) The soil in which the grass grows; and 4) The eagerness and aims of the grower. Maximum potential water use by turfgrass is about that from a weather bureau evaporative pan with a shallow depth-free water surface. Pan losses are related to three things: heat, humidity and wind. The hotter and drier the air above the wet surface, obviously the more moisture the air can take up. The warmer the water the easier for the molecules to jump out as water vapor carrying heat energy as they go. Wind takes away air partly filled with water and brings in drier air, like mopping with dry towels. In absolutely still air, a layer of moist air builds up at the water surface. Moisture and heat loss is less because it is moving by slow diffusion further and further away from the source — a little like using a damp towel to wipe up a spill.

The leaf surface is a water source just like the pan surface. Moisture and heat loss will depend on the same outside factors. However, most of the moisture is lost from only special portions of the leaf. In a turf this can be from cut ends right after mowing before they seal off. In all plants it is primarily from the stomata or breathing pores. Open pores will obviously lose more water than closed ones. They close when plants wilt and they close at night. Size and number can affect moisture loss, but the biggest resistance to water vapor leaving the leaf (and carrying heat with it) is the boundary layer of moist air next to it. Even with air movement there is always some resistance near the surface. It's no accident that problem bentgrass golf greens that get sick a lot tend also to be ones with lots of low shrubbery or trees around them and poor air movement. The air is more humid and the grass gets hotter with the same sun. Disease organisms like moist conditions and weak grass.



Moisture leaves the leaf until outside humidity is the same as the leaf surface or until moisture becomes unavailable in the leaf itself. The bigger the difference between moisture inside an open stomate and moisture outside, the faster the loss. We can cut this difference by making the outside wetter or the inside drier and by so doing, reduce water use by the plant. Wetting the outside costs water and drying the inside reduces growth. Some form of compromise between maximum growth with no water stress and no growth with too much water stress is what we need with turf. Our growth should be enough to look good, replace wear, or restore puttability but with a minimum of mowing required. We are fortunate that with turf we really don't need maximum production. (On a golf course groomed properly for a major tournament, for example, grass is on the dry side.) This means less than optimum water and less water use, but how much less for each is largely art so far. With proper data we should be able to calculate and use the right watering scheme for any given level of growth. To do this, we need uniform and precisley controllable irrigation — not always presently available to many courses. Systems capable of uniformity and precision can be designed and installed and water costs may well be the factor for getting them. Never skimp on initial design. You lose more than you gain every time.

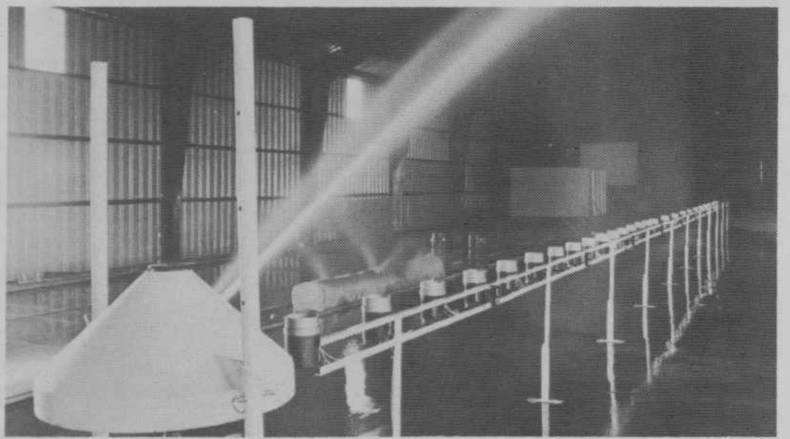
To get back to factors affecting water use, water at the stomate comes through the plant from the roots and into the roots from the soil. Roots vary in extent and efficiency. The most effective portion of a root is near the tip where active growth takes place and where thin-walled root hairs provide extra absorptive capacity. Old roots are covered with corky tissue and absorb water much more slowly. This means that, assuming soil mositure is available, plants with actively growing roots can take water up better than those whose roots are old and stalled. Grass roots are not perennial. They not only get old, but they die, usually in a matter of months, and must be replaced with new ones. Plants with large, young, actively growing root systems can draw from a bigger soil reservoir than those with short roots and they can take up water at higher moisture tensions.

Various research studies with crop plants have shown that root growth is affected less by water stress than top growth. This is logical because the roots are closer to supplies and also cooler. Less than optimum water rates for tops may still be all right for roots and encourage deeper rooting. This is one of the solid facts behind recommendations for less frequent, deeper waterings.

The luxury apparent in this scene is deceiving. It doesn't last long enough, nor happen often enough.

Even though water is an excellent management tool and we can manipulate plant growth with it, when we talk water use, we're really interested in saving water costs. How can we do this now and what hopes are there for the future?

As a breeder I am confident that varieties can be developed in every turfgrass species that will require less water for the same quality. We haven't been able to show differences between Santa Ana, Tifgreen and seeded bermudagrass in our water use studies, but an earlier study showed that long-time stress affected different bermudas differently. Seeded bermuda comes back after drought that knocks out Tifgreen, but Tifgreen looks better on the way down.



The distribution efficiency of sprinkler heads is important in determining the amount of water an area will get.

We have shown that there are significant differences in root depth in bentgrasses. Penncross (and I suspect Penneagle) show up well this way. Common bermuda roots seem less infested by ground pearl than Tifgreen roots. This makes common a better bet in Phoenix when things get really dry.

Until we get the miracle grasses that don't need to be watered, we need to consider ways to use less on the ones we have. When California went dry they learned that roughs didn't need watering, fairways needed good lies only in landing areas and approaching the greens, and when the pinch really came, golf could be played with only greens and tees watered. A talk by A. C. Sarsfield at the 1978 Turf and Landscape Institute in California pointed out a lot of things we could do, and they learned to do. As he said, they learned that water really does run downhill, too fast, too long, does puddle and run off, and shaded areas and ground covers really don't need as much water as turf in full sun.

What did these discoveries initiate? They rezoned irrigation systems to water areas with different requirements differently. They put check valves in lines so water didn't drain out in puddles around low heads. They relocated heads for more efficient distribution. Programming was adjusted daily as needed instead of a standard repeat that provided extra to avoid trouble. Mowing was raised and fertilizer reduced to cut down grass demand (and save money, too.) Aeration and verticutting were done when it was cool. Ornamentals and ground covers were put on drip systems.

All this allowed "surprisingly successful turfgrass landscape maintenance" with 50-60% of previous water use. I don't think it's surprising. Extra care makes things better and the time to arrange it is before the crunch. We can learn and we can save. Northern California is reaping the benefit in water savings now from a panic crisis situation then. If we're smart, we won't wait for a crisis.